Energy for Development in South Asia: addressing energy inequality sustainably

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Contents

Executive summary	**4**
Introduction	**5**
The energy gap	**4**
Energy and inequality	**9**
Energy for development	**14**
Conclusions and recommendations	**20**
Endnotes	**22**

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Cover: solar panels on a roof in Koderma, Jharkhand state. This part of India is home to many adivasis (indigenous peoples).

Photos – Front cover: Christian Aid/Tom Pilston, page 5: Christian Aid/Jenny Matthews, page 10 Christain Aid/Alistair Dutton, pages 12, 14, 18, 19 and 21: Christian Aid/Elizabeth Dalziel

Executive summary

Lack of access to modern, clean energy hinders economic development and perpetuates poverty. It deprives poor people of opportunities to improve productivity and their quality of life, and so reinforces inequalities.

South Asia's economies are developing fairly rapidly, but energy production has not kept pace with rising demand. More than one-in-four people in South Asia live without electricity. And more than 80% of people use wood or dung for cooking – lacking access to affordable alternatives.

This report focuses on decentralised, renewable sources of energy as a solution to meeting the needs of households and small-scale industries, and proposes sustainable and affordable strategies for closing the gaps in energy provision, with a focus on the needs of people on low incomes.

Three common factors are contributing to energy poverty in South Asia: the difficulty and cost of providing conventional power infrastructure to reach the large numbers of people who live in rural areas; heavy dependence on traditional fuels for domestic use; and, at national level, an undesirable dependence on (often imported) fossil fuels.

The current approach to delivering energy in the region remains largely focused on extending centralised services such as the electricity grid. But this has not addressed energy poverty, particularly for rural areas, and has significant environmental costs. Subsidies for electricity and fuels such as kerosene, aimed at reducing energy costs for the poor, have not been effective in reducing inequalities in energy access.

The common perception is that all renewable energy (RE) is expensive and inefficient, but comparisons with conventional systems show that locally appropriate renewable solutions can be cost effective to deliver energy to marginalised communities, particularly where enabling policies are in place to encourage investment and reduce risks. Such solutions rely on the right technologies, commercially viable business models, supply chains that can reach remote areas, consumer information and acceptance, community involvement and innovative financing.

With significant progress towards development of RE technologies and their deployment already established in some parts of South Asia, a greater emphasis on these could further help to address poverty and inequality and meet household energy needs in a sustainable way. South Asia's energy sector must rebalance its priorities, to ensure clean, affordable, sustainable energy and better integration of energy and development needs. To support this, energy planning will need to consider all stakeholders and take a more 'bottom-up' approach.

Recommendations for leaders and policymakers:

- Design energy policy from a sustainable development perspective, emphasising equity and considering gender, household and local development needs, appropriateness of technologies, and their true costs and benefits to the environment and to society.
- Share innovation, appropriate technology and knowledge across South Asia.
- For those countries that have yet to do so to sign up to the UN Sustainable Energy for All initiative, and to support its vision of making sustainable energy for all a reality by 2030.
- Target fuel subsidies to help lift poor communities out of poverty and stimulate domestic demand and local markets for RE technologies, and phase out unsustainable subsidies.
- Help decentralised energy companies access finance – in particular, affordable working capital to keep businesses viable.
- Industrialised countries should play a leading role in the development of sustainable energy technologies and do more to facilitate technology transfer. A 'leapfrog fund' should be established as part of the new UN Green Climate Fund to support Asia's progress towards a low-carbon economy and to pursue energy access and sustainable development.
- Civil society organisations have an important role to play in highlighting people's needs and integrating energy services into development interventions to ensure resilient livelihoods.

Introduction

This report discusses the links between energy access, poverty and inequality in South Asia. It highlights the need for energy policy to address equity issues, and considers the limitations of conventional models of power generation and supply to meet energy needs of the poor in a sustainable way. It proposes an alternative model of 'energy for development' that makes use of technologies to access decentralised, renewable sources of energy that have a range of economic and environmental co-benefits, contributing to more sustainable and equitable development.

In her hut, Bashnti Vahvakpa, from the tribal Shabar community in Rupabad, Jharkhand state, India, cooks on a wood-fuelled stove.

The energy gap

The extent of unmet energy needs

South Asia's economies are developing fairly rapidly, but energy production has not kept pace with demand. This is hindering further economic development, and 'energy poverty' affects many households.[1] Social and economic inequalities in the region are further reinforced by the disparities in energy access.[2]

One in four people in India and Nepal, and about one in three in Pakistan and Bangladesh, live without electricity. Additionally, four out of every five people cook on traditional wood or dung fires. All these countries have several things in common: large populations living in rural areas, some of which are particularly hard to reach with conventional power infrastructure, a dependence on fossil fuels (which are both polluting and often imported and therefore especially vulnerable to price fluctuations), and heavy dependence on traditional fuels for domestic energy needs.

Access to electricity is improving across the region, but the numbers (see Figure 1) mask the fact that even where electricity is available, levels of consumption are often very low, because of poor quality of supply. In India, annual per capita consumption, at 684 kWh,[3] is very different to that of other emerging economies such as China (3,298 kWh) and Brazil (2,438).[4] Energy consumption per capita in Pakistan and Sri Lanka is slightly less than in India, and in Nepal and Bangladesh the figures are among the lowest in the world. This reflects the lack of access to energy for many households. India had a peak power deficit (a shortfall in electricity supply when demand is at maximum) of between 4% (5,378MW) in January 2014 and 11% in January 2013.[5] On average, the supply deficit in Pakistan is of around 5,000 megawatts (MW), and it touched a peak of over 7,000MW in July 2012.[6] A good indicator of energy poverty is the International Energy Agency (IEA) Energy Development Index (EDI),[7] which ranks nations according to levels of household access as well as energy use for public services and productive purposes. Out of 80 countries, Sri Lanka ranked 42, India ranked 41, Pakistan 44, Bangladesh 48 and Nepal 74.

Current challenges to energy supply across South Asia

Across the region there are significant limitations to energy supply:

- In Bangladesh, the majority (87.5%) of electricity generation has been from local natural-gas supplies. Although this energy source is still being developed, supplies have not kept pace with rising demand, and the gap has been filled by coal, diesel, liquefied natural gas and liquefied petroleum gas. Energy shortages are the most critical constraint on Bangladesh's economic growth.
- Nepal has vast potential for hydropower that far exceeds its domestic needs, but just 1.4% of this has been exploited so far. Instead, the country remains heavily dependent on imported petroleum products and electricity generated in India, which is both adverse for its balance of payments and constrains industry.
- Pakistan depends heavily on indigenously produced natural gas for power generation, but low growth in supplies has become problematic, and petroleum products (and increasingly, coal) are used to make up the deficit.
- In India, coal has been the mainstay for power generation, but India's coal is high in pollutants and low in calorific value. Seams are often located in ecologically sensitive or densely populated areas, which make it hard to extract. Increasingly, it is supplemented by imported coal, adding to costs. Coal-generated electricity, and its distribution to remote villages, is becoming increasingly uneconomic.

Sources: Low Carbon Development Case Studies for Bangladesh, Nepal and Pakistan, Practical Action Consulting, 2014; Electricity for All in India: why coal is not always king, Vasudha Foundation, 2014. Available here: www.christianaid.org.uk/resources/policy/climate/low-carbon-south-asia.aspx'

Figure 1: Extent of unmet energy needs in South Asia, as of 2011

Country	Population without electricity (millions)	Electrification rate %	Urban electrification rate %	Rural electrification rate %	Household dependence on traditional biofuels (primarily wood) %
India	306	75	94	67	82
Pakistan	56	69	88	57	81
Bangladesh	61	60	90	48	89
Nepal	7	76	97	57	81
Sri Lanka	3	85	96	84	79.5

Source: International Energy Agency, World Energy Outlook, 2013 (comparable figures for Afghanistan, Bhutan and the Maldives unavailable) and Global Alliance for Clean Cookstoves.

Barriers to energy access

Governments in the region have tended to equate energy services with electricity generation (although electricity alone does not meet all energy needs). Typically, electricity has been generated through thermal power plants or large hydropower dams and distributed through national grids. However, it can be prohibitively expensive to extend national grids to remote rural areas, particularly where these have an extreme climate or topography, such as the mountainous regions of Nepal. Where the standard of infrastructure is poor, transmission and distribution losses can make grid extension costly for the large networks, and there is concern that poor consumers cannot pay for the associated real costs of energy services. **A key question, therefore, is whether centralised energy services are the best solution to energy poverty, and particularly rural energy poverty, in the South Asian context.**

Despite some very encouraging progress, especially in India, Nepal and Bangladesh, the potential of alternative sources of renewable energy (RE) and technologies to provide clean, sustainable energy has yet to be fully realised. These alternative solutions can meet a variety of energy needs, either deployed 'off grid' or through 'mini-grids' that supply a limited area. Mini-grids can distribute energy supplied from a variety of sources at affordable cost, and can also be linked into national electricity grids. These alternatives can help to overcome some of the barriers to universal access in the short-to-medium term. In the longer term, a combination of grid-connected, centralised and decentralised RE sources is probably the most desirable solution for secure energy access for all.

Increased investment in large thermal power plants has not resulted in corresponding improvements in energy access for people on low incomes. In India for example, the capacity for electricity generation, mainly from thermal power, almost doubled from 118,426MW in 2005[8] to 228,721MW in 2013, and yet the proportion of households without access to electricity only fell from 38% in 2005[9] to 25% in 2013[10] – and by far the greatest reduction was in urban areas. In rural areas, the rate of unelectrified households remained at 33% in 2013.[11] In much of the region significant power deficits to meet the needs of rapidly expanding industries persist, with the result that poor consumers in rural areas often receive less priority. This means that even where the infrastructure for centralised power does exist, it still does not guarantee benefits to all. It is notable that energy poverty in India is actually highest in some of the states where coal reserves, power stations and associated energy infrastructure are concentrated.[12] Similarly in Nepal, larger hydropower plants are directly connected to the national grid a number of kilometres away, so that the rural communities living next to the power stations often have no access to the power produced.[13]

A view of Kolaghat thermal power plant in East Medinipur, West Bengal, India.

The assumption that many rural households are unable to pay for energy services also needs closer scrutiny. The relationship between incomes and energy access is complex, and ability to pay is not the only issue. 41% of India's rural households that are not income-poor remain energy poor,[14] largely due to poor quality of service. Research suggests that willingness to pay for energy services is linked to quality of supply and opportunities to benefit from these services (see'Can't pay or won't pay?'). One incentive to accessing energy services is the opportunity to earn income through micro or small enterprises. For small businesses, reliability, capacity and quality of supply are as much critical factors as affordability.[15]

In some counties, efforts have been made to make electricity affordable to people living below the poverty line, through subsidised rural electrification and energy access programmes. These schemes have helped improve access to energy and go some way towards reducing the significant proportion of household income that poor people spend on fuel, but they are very costly, and many rural communities in South Asia still remain off-grid or energy poor. Energy subsidies do not necessarily reduce inequalities in energy access. Where there is no reliable electricity supply, even subsidised tariffs can be poor value for money, because irregular supplies limit the range of uses for electricity and its overall consumption. Energy subsidies can also exacerbate or reinforce income inequalities. Those that are applied to fuels such as kerosene and liquid petroleum gas tend to benefit the better-off urban consumers most, because they are the ones who can afford to buy more of these fuels.[16] In rural areas too, it is the better, off, such as farmers who own vehicles or use generators for pumping water for irrigation, who enjoy greater benefits from subsidies.[17] An analysis of energy subsidies in Bangladesh, looking at a range of fuels and income brackets, concluded that they are largely inequitable and represent a significant reallocation of public funds to higher-income earners.[18] Subsidies on fossil fuels are problematic for a number of reasons. As well as being can be a burden on public spending (levels of consumption subsidies for fossil fuels are particularly high in Bangladesh and Pakistan, as compared to their GDP), they can encourage over-consumption, which adversely impacts both the adequacy of supply and the environment. From an equity perspective, a survey including India, Pakistan, Bangladesh and Sri Lanka suggested that the proportion of fossil-fuel subsidies that were reaching the bottom 20% income brackets in 2010 ranged from 5-15% depending on the fuel type.[19] **Energy subsidies need to be carefully targeted, and ideally should discourage use of fossil fuels and incentivise renewable energy. Where used, monitoring and accountability mechanisms must ensure that they are effective in reducing inequalities in energy access as well as income inequalities. Alternatives to energy subsidies, such as tax incentives to promote investment in renewable sources that serve poor communities, and cash/income support for poor households to enable them to meet their energy needs, should also be considered.**

Can't pay or won't pay?

A survey of 1,920 households, conducted by Vasudha Foundation in India, found that while 1,881 had electricity connections, just 677 had a power supply of 20 hours or more per day. The remainder had electricity from 4-12 hours a day. Subsidised electricity services were widely considered 'unworthy of payment', because of the poor quality and timing of supply. People's willingness to pay for energy services was based on a range of factors such as duration and regularity of supply, ease of connection, and the potential impact on education, livelihoods and other aspects of life.

Energy and inequality

Social fairness is essential for sustainable development, and should be central to energy policy. Yet industrial and commercial centres are often given priority for electricity supplies, leaving least-developed areas to wait for improved access – constraining development and trapping people in poverty. **Access to clean, modern energy is critical for human development, poverty reduction and reducing wealth disparities.**

Geographic inequalities

There is a strong trend towards urbanisation across the region, and rising demand for energy in urban centres. In this context is it important that the needs of rural communities are not overlooked. Generally urban centres fare better than rural areas in terms of energy access. The significant disparities between urban and rural access to electricity (see Figure 1) contribute to wealth and development disparities between rural areas and urban centres. In Nepal and Bangladesh, almost all urban dwellers have grid electricity as compared to only about half the rural population. In India, this disparity varies from state to state, but overall in 2013, urban areas had a 94% rate of electrification, and rural areas just 67%.[20]

Even with a grid connection, rural households are more likely to have unreliable or intermittent supply than those in urban centres. Often, electricity is only supplied during the hours of darkness, so its use for productive purposes is limited. In rural areas, poor maintenance of transmission and distribution infrastructure often results in frequent power outages, sometimes for days at a time. In rural India in 2011, average per capita electricity consumption stood at 95 kWh per year. This is in stark comparison with urban areas where average consumption stood at 700 kWh per capita per year,[21] reflecting higher rates of household electrification and a generally more robust infrastructure for delivery. Since 2009, Pakistan has experienced power outages ranging from 12-16 hours in urban areas and up to 20 hours in rural areas.[22] Poor supply is one of the reasons why household electricity, when available, is often usedonly for lighting, rather than other activities or appliances that could help improve lives and incomes.

In rural areas in much of South Asia, cooking and heating needs are overwhelmingly met through use of traditional fuels such as wood, crop residues and cow dung, even in 'electrified' households. This has enormous health implications. Globally, more than 4 million deaths a year are associated with indoor air pollution (due to smoke from cooking fires) – and the numbers are particularly acute in South Asia.[23] An average household in Pakistan, for example, consumes 2,325kg of firewood or 1,480kg of dung or 1,160kg of crop residues each year, with an estimated 70,700 associated deaths in 2007.[24] The percentage of national burden of disease attributed to solid fuel use is 4.6%, compared to less than 1% in the developed world.[25] Throughout the region, women are more exposed to this pollution than men, and are at higher relative risk of developing poor health as a result of their greater involvement in daily cooking.[26] There are also economic costs. At household level, these include time and money spent on getting hold of traditional fuels, or backup electricity in the forms of batteries and diesel generators, or fuels such as kerosene. Farms and other businesses are also affected, with implications for economic development.

Gender implications

Dependence on traditional biofuels has significant implications for gender equity. Where household fuel is not purchased in markets or from vendors, it is typically women and girls whose task it is to find, gather and transport it, often over long distances. This, along with other household chores such as fetching water and tending cook-stoves, disadvantages women from a young age, because time is reduced for study and schooling, with profound for opportunities into adulthood. The critical importance to women of clean, affordable and sustainable energy at household level is illustrated by the case study on page 10 taken from Vasudha Foundation's community energy project.[27]

In Enayatpur village, Bangladesh, a woman makes fuel-sticks out of cow dung

In addition to individual household requirements, energy is also vital to ensure water supplies and other public services at community level. In many parts of South Asia, water is pumped from underground aquifers through tubewells and/or piped to where it is needed. This is especially important for women and girls who are often responsible for transporting, storing and the hygiene of household water supplies, and whose dignity and health is disproportionately affected when water and sanitation facilities are too distance or inadequate. While the majority of households in the region now enjoy access to improved drinking water, levels of access to improved sanitation are still as low as 29%, in Afghanistan, and 36%, in India.[28]

'I have a very small piece of land. Until about six months back, it was primarily used to stock and dry firewood. Now, with a biogas plant installed, I'm able to grow vegetables. Before, my income was from making pathal plates (plates made out of leaves). I now earn income from selling vegetables and make three times more leaf plates than before. I am also able to sell five bags of organic fertilizer from the biogas slurry every month, giving me additional revenue of Rs150. If I get an electricity connection, I can make even more leaf plates, in the evenings.'

Khago Devi,
from Lalpur Village, Jharkhand

Also often overlooked is the need for energy for reliable lighting in public spaces and the particular importance of this for the safety and security of women and children.

As women have less voice in decision making than men, their needs in relation to water, sanitation, privacy and personal safety are often overlooked, reinforcing gender inequalities in health and other development outcomes.

Women's empowerment can be one of the positive benefits of energy access. A review of the evidence of the differential impact of energy access on women and men found that access to electricity can allow women more time for socialising and more access to information/media. Among communities with access to electricity used for watching television, attitudes towards gender roles and issues such as domestic violence were also improved.[29]

Identity-based inequalities

Social inequalities and disparities in levels of human development between different social groups are exacerbated by unequal access to energy services. South Asia has significant populations of indigenous peoples, the vast majority of whom live in remote areas and are disadvantaged in various ways including by language, discriminatory attitudes, and lack of access to quality services. The majority of dalits[30] also live in rural areas and are therefore less likely to enjoy adequate energy access. In the largely rural state of Bihar, India, in 2008/9, 26.3% of scheduled castes and 27.9% of scheduled tribes had electricity for domestic use, as compared to 58.5% of other groups.[31]

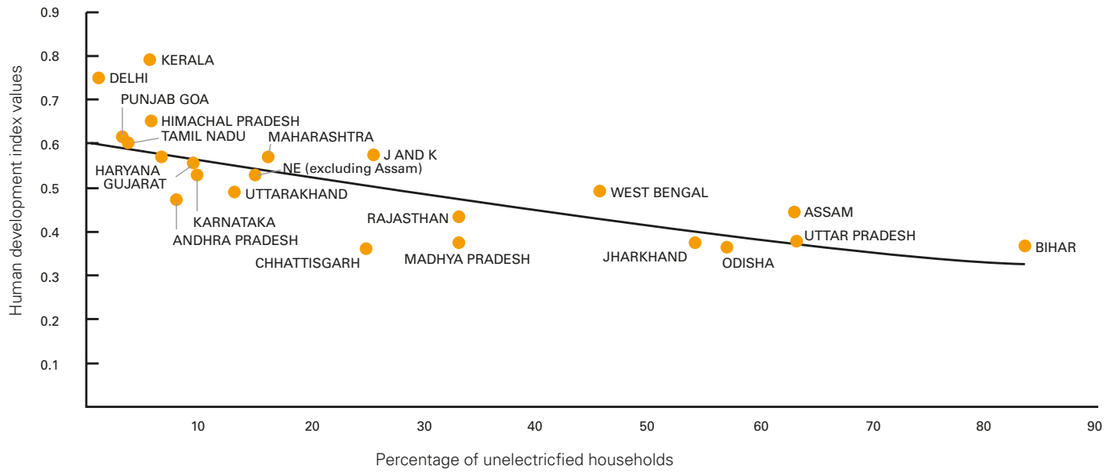
Social exclusion of marginalised groups means that even in towns and cities there are disparities in access to services. Dalits, especially, are most likely to reside in segregated housing, some distance from the wider population and from most infrastructure and service provision. For socially excluded groups, however, the 'social distance' resulting from discriminatory attitudes and lack of representation or voice is perhaps even more significant.

A national infrastructure equity audit conducted by civil society organisations in India, looked at the placement of a range of infrastructure services, and how these contribute to perpetuating poverty. The audit assessed areas in five of the poorest states, overseen by 124 village-level administrative units, including 727 hamlets housing marginalised groups (classified as scheduled tribes (ST) or scheduled castes (SC)). It found that the settlements of the marginalised communities are more likely to be bypassed in provision of infrastructure services. In more than 10% of villages where electricity was available, the service was not provided to areas inhabited by scheduled castes and scheduled tribes, and a range of other services such as schools and water points were also largely concentrated in areas occupied by dominant castes or other social groups. The study found a continuing, deep-rooted caste-based inequality in distribution and access to infrastructure, and hence to the accessibility of a range of services and entitlements.[32]

Energy access and human development

Clean and modern energy is critical for promoting human development, reducing poverty and narrowing wealth disparities. Globally, there is broad correlation between the Human Development Index (HDI) and household electrification. Figure 2 illustrates this for India at the state level. Among the South Asian countries, this trend is less clear (See Figure 3), but while there is no simple causal relationship, availability of energy services is important for advancing many aspects of human development. For very poor households, even a small increase in electricity consumption can lead to a marked improvement in quality of life, for example by enabling a shift away from costly fuels such as kerosene, reducing

Figure 2: Relationship between household electrification and HDI in India



Members of a study group do their homework by the light of a D-light solar panel lamp in Lalpur village, Jharkhand , India.

time spent on tasks such as collecting firewood, and improving health through better indoor air conditions. In countries where there are extremely high levels of poverty therefore, increasing the opportunities for energy access among poor households could significantly boost HDI levels and reduce inequality.

Energy is essential for expansion of economic activity and market access. It can widen the range of productive and commercial enterprises, and opportunities for productivity enhancement, value addition and employment, for example through irrigation, cold storage and food processing. For small-scale food producers in rural areas, this can help diversify livelihoods and support resilience to environmental and economic shocks.

Energy is also critical for the provision of essential services. Schools and learning can be vastly improved where reliable energy is available at reasonable cost. Improved facilities can, in turn, contribute to the retention of teachers, which can be an issue in remote rural areas; and it may also reduce drop-out rates among pupils, who can benefit from increased hours of study. Less than 50% of primary schools in South Asia have access to electricity; and information technology and computer sciences, which can open up opportunities for education and employment, are not available in the majority of schools. [33]

Health services, including essential preventative measures such as vaccination programmes, are very dependent on energy access, yet only about 50% of healthcare facilities in India had electricity in 2011[34] While the proportion is higher in Bangladesh, at around 75%, in both countries the major issue is unreliability of supply (blackouts are frequent), which limits the range of health services that can be provided.[35] The IEAs energy development index analysis, mentioned earlier in this report, highlights the very limited amount of energy used for public services in all the South Asian countries.

Energy, inequality and the environment

The way energy is produced also has a bearing on inequality, as the poor are often worst affected by adverse impacts. When calculating the costs of power-generation, the huge costs of environmental degradation, health impacts, rehabilitation costs and livelihood displacement are rarely taken into account.

The polluting effects of conventional power generation through coal-fired power plants are well known, but their other detrimental environmental and social impacts, including the land sacrificed to coal mining that could otherwise be used to produce food, and displacement of farmers and pastoralists, are rarely quantified. In South Asia, the building of large dams to generate hydropower has also been contentious because this too causes displacement and also trade-offs between electricity generation and water/irrigation needs. Where huge numbers of people face food insecurity and the impacts of climate change, attention needs to be paid to the food, water and energy nexus. Increasing food production and ensuring resilient food systems will depend on energy access for irrigation, mechanisation, processing, storage and distribution. As constraints on water supplies increase, coal-based electricity generation, which requires huge quantities of water for mining, processing of coal and cooling, is becoming less sustainable. At the same time, both food and energy production can impact on the quality of water available for drinking, depending on the approaches used and the environmental safeguards in place. Energy production can also have a severe impact on the availability of land for agriculture, fisheries and other natural resource-dependent livelihoods. It is often the poorest communities who suffer the worst consequences as the conflict over a proposed coal-mine in Bangladesh, described below, illustrates. The environmental costs and benefits of different energy sources, and how these are unevenly distributed in any given social context, need to be better understood and factored into cost/benefit analyses.

Figure 3: Relationship between household electrification and HDI five South Asian Countries

Country	Percentage electrified households	HDI	Ranking (out of 187 countries)
India	75	0.586	135
Pakistan	69	0.537	146
Bangladesh	60	0.558	142
Nepal	76	0.54	145
Sri Lanka	85	0.75	73

Coal and inequality

The trade-off between the livelihoods of the poor and large-scale conventional energy projects is illustrated by the disputed plans for an open-pit coal mine in Dinajpur district of northwest Bangladesh. There are concerns that this could displace up to 220,000 people from access to land and water resources. 14,660 acres are earmarked for the project, 80% of which comprises some of Bangladesh's most fertile and productive farmland.

Some 23 different indigenous communities live in the affected areas and 80% of local people depend on the land for their survival, but there are no plans for their resettlement on replacement land.

The loss of these productive farmlands could undermine efforts to achieve and sustain food security in a country in which over a third of all children and nearly 17 percent of the entire population are undernourished and food insecurity is frequently exacerbated by disasters. These problems are particularly acute for indigenous peoples who are less well equipped with the skills and education needed to find alternative sources of livelihood during periods of food shortage.

The area in question contributes food for the national economy as well as for local subsistence. As well as the loss of farmland, waterways supporting over 1,000 fisheries could be destroyed. In addition, the mine could lower the water table significantly, threatening access to safe drinking water and sanitation in the area.

Sources

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Bashnti Vahvakpa gathers wood to fuel her stove in a tribal village in West Bengal , India.

The fuel-wood crisis

As populations grow and natural resources are increasingly depleted, dependence on traditional biomass fuels (particularly wood) is becoming more problematic, adding to the difficulties faced by poor communities. When supplies are not managed sustainably, shortages of fuelwood push up prices for domestic consumers and can contribute to deforestation and its associated impacts, including landslides, soil erosion and desertification. In Nepal, the share of fuel-wood in household energy consumption is projected to remain dominant even until 2030; and in absolute terms, consumption is likely to increase by an average of 2.5% annually in the foreseeable future.[36] Nepal ranks 8th globally for the worst deforestation rate of primary forest. Sustainable forest management and efficient use of fuel-wood including through the introduction of more efficient domestic cookstoves, must be made a high priority.

Climate change

South Asia faces some of the worst impacts of climate change, including a growing frequency and severity of extreme weather, sea-level changes and glacial melt.[37] The huge populations exposed to these impacts are largely very poor, making them particularly vulnerable. Resilience to disasters (climate related or otherwise) and ability to adapt to climate change would both be strengthened by more secure access to energy.

The future will also require development of more sustainable energy options for mitigating carbon emissions. The region contributes only a small share of global emissions, but economic development, changing patterns of consumption, and the growth of urban centres are rapidly growing demand for energy. As a result, greenhouse gas emissions have risen in South Asia by about 3.3% annually since 1990.[38] There is an urgent need to reduce the carbon intensity of growth and promote the use of low-carbon energy solutions. On average, every 1GW of additional renewable energy capacity reduces CO2 emissions by 3.3 million tons a year.[39] It is also critical that the transition to low carbon energy be informed by issues of equity and social justice.

Energy for development

Energy is critical to the achievement of development goals and is a key link between growth, water and food security, poverty reduction, climate change, biodiversity, health and women's empowerment.[40] While energy had no explicit mention in the MDGs, the UN Sustainable Energy for All (SE4All) initiative, launched in 2011, has placed energy firmly on the development agenda, and energy is likely to be integrated into the new post-2015 sustainable development goals.

To overcome the barriers to universal energy access and address the environmental and equity issues associated with conventional power generation, it will be necessary to question established assumptions and promote alternative approaches. More focus is needed on decentralised Renewable Energy (RE) systems. As they generate electricity and other fuels at the consumer end, these avoid transmission and distribution costs. They are increasingly competitive, relative to conventional power generation costs, and can help overcome barriers such as unreliability of the grid and geographic inaccessibility. New RE technologies offer flexibility, scalability and faster deployment than conventional sources of energy, so they can address the supply-demand gap more quickly and at less cost to people and the environment. There are already many successful examples of decentralised RE in the region, but the potential is still under-exploited – a missed opportunity to supply cheap and sustainable power where it's most needed.

Regional potential for renewable energy

The South Asia region has enormous and largely untapped potential for supplying households and promoting economic development through decentralised RE options. These include geothermal, small-scale hydro, solar, wind, tidal and local biomass fuels (including agriculture wastes). There are already significant numbers of existing success stories, but these need to be scaled up for much wider coverage.

- Bangladesh has excellent prospects for solar energy, with about 264,000 households already using this for electricity countrywide. With an abundance of biomass, potential for bio-diesel (using rice husk or other crop residues) is also high, though exploration of these resources for electricity generation is still at an early stage. Biogas is being used in about 50,000 household and village-level biogas plants, and there is huge potential for expansion in rural areas.[41]
- In Pakistan, the solar potential, using current technology, was estimated to be 149 GW in 2010 and with improvements in technology could be 169 GW by 2050. For wind energy the potential is around 13 GW. The potential from biomass energy sources could be 15 GW in 2050. The capacity of currently installed small-hydro plants could reach 3 GW. So far, wind and small-hydro plants have had the most focus but there is a great potential in solar and biomass technologies.[42]
- Nepal has 18.1MW of micro-hydro projects, providing electricity to 180,755 households, with a target to install capacity to electrify 150,000 households by 2017. It also has the potential for up to 1.9 million biogas plants, with 290,510 household biogas plants already in use in 2012 and an additional 130,000 household, 200 community and 1,000 institutional and 5,000 urban biogas plants planned by 2017. Conditions for solar energy are also favourable, and installations of solar water heaters, dryers and cookers numbered 185,000 in 2009. 411,258 solar home systems (mainly for lighting) are also in use.[43]
- India has taken a number of steps towards increasing the share of RE sources, and its existing target is 75GW of RE by 2022, which will be roughly 20% of total electricity generation. Further, states have put in place a number of measures to enable decentralised renewables and 'roof-top' (household) renewables. India has focused attention mainly on large-scale hydropower development, ,and it also has significant geothermal potential – with some 340 hot springs that could supply about 10,000MW,[44] and an estimated total wind potential of 48,561MW (of which about 36.3% had been installed, as of June 2012). Government targets included production of an additional 2,500MW of wind power in 2012/2013. India's total solar power installed capacity was reported to be 1,030.66MW in 2012, with plans for a further 800MW of solar power in 2012/2013. The realisable potential for solar-powered water heating systems in India is estimated at 40 million m^2, of which nearly 5 million m^2 had been installed as of 2011.[45]

While the potential is huge, of course, there are challenges. The initial investment costs for decentralised RE technologies can be high, and there is sometimes a lack of confidence on the part of investors that they will recover costs. However, the next section of the report challenges this assumption. Issues holding back RE development[46] in the region include:

- 'path dependence', caused by existing energy infrastructure, and policies and politics that support the status quo.
- pricing and regulatory policies and practices that ignore the external costs of conventional energy sources
- the need for human and institutional capacity building
- a history of public and private monopolies in the energy sector that have not supported stand-alone mini-grid or off-grid technologies
- technological constraints, including the inadequate capacity of national grids to absorb RE sources. One of the reasons for a lack of business investment into the off-grid and decentralised RE sector is the fear that future grid extension would render investments unprofitable and assets stranded, leading to decentralised systems being discarded in favour of grid connections. Policies are needed to ensure that any grid expansion would allow for the integration of existing decentralised systems. This will require long-term investment to strengthen national grids to enable their transition to supporting 100% RE with significant decentralised capacity.

Policymakers in the region have begun to take on board the opportunities for developing RE through enabling policy frameworks (see box), but there is a need for greater ambition and renewed political will for implementation and to and overcome the technical, financial and institutional challenges.

Policy responses in South Asia

South Asian countries have started a wide range of specific initiatives to encourage renewable energy (RE) and energy access, but much more could be done to further progress of these.

- The Government of India has established the Indian Renewable Energy Development Agency (IREDA) to support financing of RE, and it plans to increase its share of RE through fiscal and other incentives applied at state level. However, the policy framework remains biased towards financing fossil-fuel based projects and, as of 2013, 57% of India's electricity was still generated from coal, while 19% was generated from hydropower (mainly large-scale grid-dependent installations), and just 12% generated from other renewables and decentralised alternatives.[58]
- In Nepal, the Alternative Energy Promotion Centre (AEPC), established in 1996, has helped to make Nepal a world leader in promotion of decentralised small-scale RE technology. AEPC is currently implementing a five-year US$170m National Rural and Renewable Energy Programme (NRREP). A range of financing mechanisms, institutional arrangements, deregulation, quality control, and a market approach in service delivery have successfully encouraged private sector investment and supported profitability. The micro-hydropower sector, for example, has successfully supplied services to very remote and scattered communities.[59]
- The Bangladesh Renewable Energy Policy was developed in 2008 and aims to generate 10% of energy needs from renewable sources by 2020, but establishment of the associated Sustainable and Renewable Energy Development Authority is still in progress.[60]
- Pakistan established an Alternative Energy Development Board in 2013, with a target of 5% of total installed capacity by 2030.[61] So far, only a few pilot projects have been implemented.
- At the regional level, in 2008 the South Asian Association for Regional Cooperation (SAARC) adopted an Action Plan on Climate Change (ACCC) to enhance South-South cooperation. The plan proposes sharing best practices to address mitigation, cooperation on technology sharing and transfer, and creation of a financing mechanism to support climate-change actions and build public awareness.[62]

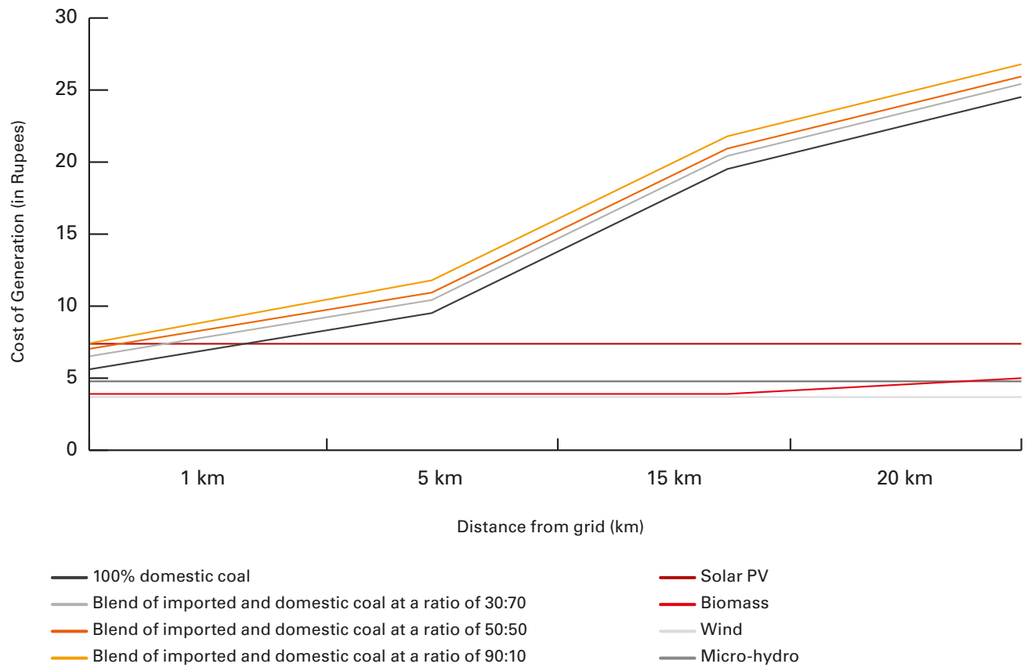
Challenging the myth that renewable energy is too expensive

There is a widely held perception that all renewable energy (RE) is expensive and inefficient compared to conventional grid electricity, but this no longer holds true in every case.

The cost competitiveness of RE technologies is greater in rural areas where the extension of national grids would be problematic. During recent years, technological innovation and related cost reductions have greatly enhanced the opportunities for deploying RE technologies off-grid, and the profitability of energy production using decentralised technologies is also improving. Solar photovoltaic technology and onshore wind power have both reached 'grid parity' in a variety of settings[47]

A comparison of the actual cost of generation with conventional systems in India illustrated this (see Figure 4). The costs of transmission and distribution when using RE systems are much lower, and there are far fewer costs relating to externalities. In addition, some RE sources can recover costs by supplying national grids, and even factoring in incentivising policies that encourage investment or the connection between off-grid/mini-grid and national grids (such as subsidised feed-in tariffs or rebates on transmission costs) the costs of decentralised RE are rapidly becoming more cost effective compared with conventional sources. In India, as of April 2014, the cost of generating electricity from wind was cheaper than generating electricity from a coal-fired power plant using 50% or more imported coal. A trend of falling prices for solar-photovoltaic technology means that experts predict

Figure 4: Cost comparison of low carbon solutions with high carbon, business as usual, energy projects



A bio-fuel stove sits in the kitchen of Gauri Mondal organic farm, in the village of Pather Pratima, West Bengal, India

the cost to consumers of solar-powered energy through the grid will achieve parity with that of coal-powered energy by 2017-19, at the very latest.[48]

The costs of developing decentralised RE and of upgrading grid infrastructure to provide greater connectivity locally and nationally, while significant, are probably outweighed by the long-term benefits that could enable the South Asia region to overcome very significant energy constraints on economic development alongside the considerable, health and environmental consequences of the current energy mix.

Some available options and their co-benefits

As well as environmental benefits, new decentralised renewable energy (RE) technologies can support local economic development and enable energy provision to be tailored to people's energy needs and to locally available resources. New technologies and practices are enabling more-efficient 'conversion' and use of RE sources including the bi-products of local industries, thus enabling integration with other economic activities. The variety of available technologies means an appropriate solution can be found for a wide range of geographic and economic contexts. The potential for decentralised RE technologies to create employment opportunities where they are most needed has also been highlighted.[49] A few examples are described here:

IDCOL solar energy programme, Bangladesh[50]

The social enterprise IDCOL has devised a credit scheme for marketing solar home system units and making these an affordable alternative to grid electricity for poor people in remote areas. IDCOL extends loan-support to its partner organisations (POs, including local civil society organisations) across Bangladesh. The POs extend micro-credit to consumers to buy the systems and, in turn, obtain re-financing from IDCOL for up to 80% of the loans given to consumers. The households are required to pay at least 10% of the system cost as down-payment. The remaining 90% is financed by loans at 12-15% interest per annum. As well as financial support, IDCOL provides technical support to develop the capacity of partner organisations.

By 2013, more than 2.5 million Solar Home Systems (SHS) had been installed throughout the country. Used mainly for lighting, SHS have contributed to educational attainment, women's empowerment and quality of life. Children from such households have a higher school attendance and duration of evening study than those without access to lighting. Women no longer have to clean kerosene lamps and households have begun using a range of appliances contributing to their comfort, access to information and income-generating opportunities. Users of SHS use 66% less kerosene per month than households without SHS reducing significantly household expenditure on lighting. Greater access to night-time lighting has also led to a greater sense of security.

Bangladesh is a global leader in SHS, and countrywide the industry employs an estimated 60, 000 people along the whole SHS supply chain.[51]

Biogas Support Partnership [52]

Biogas Support Partnership - Nepal (BSP-N) promotes biogas – clean energy produced from animal waste. Biogas drastically reduces firewood consumption in households, which saves women and children many hours otherwise spent collecting wood. Biogas replaces traditional cook stoves which are a health hazard, and the slurry (a by-product of its production) is used as agricultural manure. On average, 7.4 tons of GHG emission is reduced per household per year.

The most commonly used size of biogas plant is $4m^3$, sufficient for a family of five and costing around US$400-500. There are over 100 pre-qualified installation companies in Nepal who supply and install biogas. There are 17 biogas-appliance manufacturing workshops and 264 micro-finance organisations, which received loans from Nepal's Alternative Energy Promotion Centre (AEPC) Biogas Credit Fund to provide loans to farmers for purchase of biogas plants. AEPC also subsidises about half the cost of a family biogas plant.

As at July 2011, 258,642 household biogas plants had been installed in Nepal. The technical potential of biogas in Nepal is estimated to be over 1.3 million plants and the economic potential to be 0.6 million. More than 25,000 household biogas plants are installed each year in Nepal.

Micro hydropower and agro-processing mills in Pakistan[53]

The Pakistan Council of Renewable Energy Technologies (PCRET) is promoting renewable energy in Pakistan, especially through development of micro hydropower projects, aiming to electrify remote hilly areas. The project has installed 476 micro hydropower plants, ranging from 5-50 KW capacity, in the northern areas of Pakistan, electrifying 56,000 households. The micro hydro turbines and other necessary equipment are made by local manufacturers, helping to provide job opportunities. This technology has great potential to help promote small-scale industrial activities and agro-processing in rural areas. There are challenges, however, including that investment is required to enhance the ability of local manufacturers to produce more efficient turbines, with increased capacity, and to improve skills in the private sector for the installation of micro hydro plants.

Husk Power Systems, India (HPS)[54]

Since 2007, this private initiative has been installing mini power plants that run on waste rice husks. The husks can be purchased cheaply from rice mills, to deliver electricity to off-grid villages in the Indian 'rice belt', within 3km of each plant. It is scaling up rapidly on a 'pay-for-use' approach. About 300kg per day of rice husk can produce 40 kW of energy, enough to supply 500 households for 6-12 hours per day. Consumers pay Rs80 (about 0.8 GBP) per month for lighting and mobile phone charging but save around Rs150, which would otherwise be spent on kerosene. Low-cost, pre-paid meters have been installed that can efficiently regulate the flow of low-watt electricity. Increased lighting has lengthened business hours in the market area, reduced thefts, improved health conditions, enabled children to study after dark and encouraged new business development such as IT shops and photo studios.

SELCO[55]

Founded in 1995, SELCO makes energy services accessible to around 120,000 low-income households in India using solar-photovoltaic (SPV) technology to provide electricity for lighting, water pumping, communications, computing, entertainment, and small business appliances. It now has 170 employees in 25 energy service centres in Karnataka and Gujarat. SELCO designs and finances products based on the needs of customers and their ability to pay loan instalments. For the majority of its clients, the solar system they purchase will probably be the most costly item they have ever owned, so SELCO has designed appropriate financing schemes, working with the financial institutions, which are just as vital as the technical solutions for particular energy requirements.

After identifying an energy-poor group (for example, street vendors or rural households) and understanding their per-day capacity to pay (this is generally the amount spent by this group on kerosene for lighting), SELCO starts the product design. Once a product is designed and manufactured, SELCO uses its relationships and tie-ups with several commercial banks, regional rural banks, farmer cooperatives and micro-finance institutions, to arrange the loans to consumers. Grants from foundations and other agencies provide some support to the scheme, while consumers only spend an amount equivalent to their previous expenditure on kerosene but get improved services.

Clean Energy for Ladakh through micro-hydro[56]

Remote and topographically difficult, Ladakh, in northern India, has been an energy-deficient region. A centralised model of energy delivery has so far proved unfeasible. In 2008, the Ladakh Ecological Development Group (LEDeG) installed a 30kW micro-hydro power unit in Udmaroo village of Nubra Block, with support from the European Union, the Sir Dorabji Tata Trust and international NGOs. Since then, the unit has been functioning successfully, efficiently maintained by a village electricity committee. As a result, villagers now have domestic lighting and can use machinery for carpentry, flour-milling and oil-pressing, reducing drudgery and supporting incomes. The total installation cost of the system amounted to Rs2.2m (about £22,000). The 90 users made a contribution towards capital costs of approximately Rs1,000 per household (about £10) and also contributed labour during installation. The remaining costs were covered by grants from the various donors.

Supporting principles

The examples above show that locally appropriate solutions can be diverse and that their development depends on commercially viable business models, supply chains that can reach remote areas, consumer information and acceptance, community involvement and innovative financing mechanisms. Some principles for policymakers include:

More 'bottom-up' energy planning that mainstreams gender and equality concerns: Centralised, 'top-down' energy planning can lead to inappropriate responses and service delivery failures, with most of the increase in electricity generation used to meet the growing demand for urban and industrial sectors or exported, rather than contributing to inclusive economic development. Most energy policy frameworks need to be more responsive to the fact that limited access to energy has a disproportionate effect on women, especially in rural areas, and that it keeps people poor, reinforcing social inequalities. Greater involvement of women and excluded groups in the planning and design of energy models is critical.

Multi-stakeholder planning approaches to link energy services to development: Ministries need to work together to create policy responses that promote integrated energy services for development (not just electricity). To help reduce poverty, create jobs and expand market access, policies must take into account all the heating and lighting requirements of the poor as well as needs relating to livelihoods, micro-enterprises and sustainable transport systems. Planners should avoid compartmentalising and narrow debates. Instead, they should develop links between energy access and aspects of development, such as health, education, and water and sanitation. Better environmental practices in the energy sector, along with improvements in land use and forestry, could also be supported in this way.

Subsidies targeting poor consumers, and more effective financial and fiscal measures to stimulate investment in RE and access: More financial support for expansion of energy access could be generated through establishing funds, taxing use of fossil fuels and eliminating fossil-fuel subsidies. Tailored banking and financing arrangements, accessible to small investors, are needed to ensure investment flows in to the decentralised RE sector, to ensure the spread of initial investment costs over time, and to support consumers by ensuring affordable prices (while not affecting return on investments). Financial instruments should ensure scalability of business models, with a particular need for start up grants and affordable day-to-day working capital.[57]

Conclusions and recommendations

There is an urgent need to rebalance the priorities for South Asia's energy sectors, to ensure clean, affordable, sustainable energy, and better integration of energy and development needs. **Energy policy should be designed from a sustainable-development perspective, emphasising equity and considering gender, household and local development needs, the appropriateness of technologies and their true costs and benefits to the environment and to society.**

- National energy policies must be 'pro-poor' (successful in reducing) and, through appropriate tax and fiscal policies, incentivise the phasing out of fossil fuels, the development of sustainable alternatives, and support for energy access for the poorest groups. The use of fuel subsidies to stimulate economic development should be targeted to helping to lift poor communities, and particularly the most marginalised and excluded groups, out of poverty; and they should be applied to stimulate domestic demand and local markets for RE technologies. Policies need to help key technologies become truly competitive and widely used. Energy goals should be redefined to address development outcomes including health, gender equality and access to essential services.
- Countries that have yet to sign up to the UN Sustainable Energy for All initiative[63] should do so, and support its vision of making sustainable energy for all a reality by 2030. They should incentivise universal access to modern energy services, increase the share of RE in their energy mix, and double the rate of improvement in energy efficiency. These goals are likely to be enshrined in the new sustainable development goals (SDGs), which will replace the MDGs from 2016.[64]
- Increased financial, political and technical support for decentralised, low or zero carbon technologies is critical. Policymakers should support an enabling environment for energy enterprises to access finance, and develop proactive national strategies for energy access, including both positive mechanisms to enable energy enterprises to thrive and the responsible phasing out of policies and subsidies that encourage unsustainable energy use. Financing energy services for the poorest also requires a combination of public-private partnerships, along with social entrprise initiatives and national government investment.
- Industrialised countries should play a leading role in the development of sustainable energy technologies and do more to facilitate technology transfer. A 'leapfrog fund' from global mitigation finance should be established to support Asia's progress towards a low carbon economy and pursue energy access and sustainable development through a clean development model. The Green Climate Fund, which is being established by the UNFCCC, should include a dedicated window for this purpose.
- At the regional level in South Asia, greater cooperation, including a regional innovation centre, innovation funding and appropriate technology and knowledge sharing should be promoted.
- Donors should support growth, new programmes and innovations within the energy enterprise sector, and should broker and fund technical assistance from experienced providers with appropriate expertise. They should also continue to support development interventions that amplify the voice and influence of the most marginalised and excluded groups in decision making.
- Civil society organisations have an important role to play in highlighting people's needs, integrating energy services in development interventions for resilient livelihoods, and countering perceptions that decentralised RE are merely a 'stop-gap' measure. Alongside governments and the private sector, they can also support social marketing of RE technologies, and training for their repair and maintenance.

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